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The Clean Development Mechanism: Considerations for Investors and Policymakers

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*by Craig A. Hart**

Introduction

The Clean Development Mechanism ("CDM") of the Kyoto Protocol to the United Nations Framework Convention on Climate Change ("Kyoto Protocol") is intended to provide financial incentives that support the adoption of technology in developing countries to reduce carbon dioxide ("CO_2") and other greenhouse gas ("GHG") emissions through the creation of certified emissions reductions certificates ("CERs"). A major aim of the CDM is to promote sustainable development, including sustainable energy technologies.[1] Project developers may either sell CERs to a third party in order to raise additional project revenues or use the CERs themselves to meet their own carbon emissions obligations under domestic laws implemented pursuant to the Kyoto Protocol.[2]

Although the issuance and sale of CERS potentially provide an additional source of revenue for qualifying projects, the CDM aspects of a project involve their own subset of risks. This article evaluates CDM project risks, focusing on three risks that remain outside the control of project developers and are critical for evaluating CDM opportunities: (1) the estimation and delivery of CERs; (2) CERs price and volatility; and (3) uncertainty concerning the future of the Kyoto Protocol arrangements and the CDM. It concludes by assessing the potential for the CDM to address climate change and the development of clean energy technologies to mitigate climate change.

Overview of the CDM Project Cycle

The CDM project cycle is a multi-step process. First, project parties prepare a proposal, which sets out the design of the venture in a document called the Project Design Document ("PDD"). The PDD is then evaluated by a Designated Operational Entity ("DOE"), a private third party certified by the CDM Executive Board, which validates the project's design and estimates the expected contribution to emissions reductions.[3] During this phase, the project parties procure an environmental impact assessment, obtain the approval of the host government, and circulate the PDD for public comment. The PDD is then submitted to the CDM Executive Board who reviews it for compliance with CDM requirements. Projects involving new methodologies will also be required to obtain approval of the specific methodology. If approved, the project is registered with the CDM. Registered projects then implement a monitoring plan approved by the CDM Executive Board.[4]

Pursuant to the monitoring plan, a DOE periodically verifies the actual emissions reductions that have occurred during each verification period. Based on the DOE's written certification of the emissions reductions, the CDM Executive Board instructs the CDM Registry Administrator to issue the appropriate number of CERs to the project for each verification period.[5]

CDM Project Risks

In addition to the risks associated with project financings generally, the CDM aspect of a project entails substantial risk for project sponsors, investors, and project customers that rely on the issuance of CERs either as a source of project revenues or to meet regulatory obligations. Issuance of CERs requires approvals of the host government and the CDM Executive Board. Additionally, the actual number of CERs that a CDM project produces depends upon the verified performance of the project. Purchasers of CERs should be concerned about the financial stability and performance of the project and their ability to take legal title to the CERs.[6] As a result, CER purchasers tend to favor project sponsors with established records, countries with legal systems that will enforce project contracts, national regulatory authorities that will provide the necessary project approvals promptly, and reliable technologies.

CDM risks should be separately identified, allocated and mitigated.

As with any risk in project financing, CDM risks should be separately identified, allocated, and mitigated. This may be accomplished through the use of insurance or other similar products or through the project documents.[7]

Below we analyze several critical CDM risks commonly identified by CDM sponsors, advisors, and investors in interviews: validation/verification error, limited price visibility, and regulatory uncertainty. These are not the only critical risks identified by CDM participants. For example, high transaction costs and scalability of projects were also frequently cited risks. The risks analyzed here should be considered in evaluating the future

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TABLE 1: CDM PROJECT RISKS[8]

Risks	Examples
Market and Supply Risks	Immature market; affected by Assigned Amount Units prices, energy prices, and weather conditions.
Technology Risk	Clean technologies still developing; uncertain costs and benefits.
Certification/Verification Risk	Variation in validation and verification procedures. Proving additionality requirement. Difficulty in monitoring emissions reductions. Failure to deliver promised CERs due to validation/verification estimate error.
Regulatory Risk	CDM methodologies still developing and untested. Kyoto Protocol only extends to 2012. Potential for commodities or securities regulation.
Political Risk	Host government must approve the project under domestic laws for sustainability.
Accounting/Disclosure Risk	No standard or oversight for reporting national emissions or CDM results. Conflicts of interest among project parties.
Credit Risk	Counterparty credit risk (no exchange clears CERs).
Default Risk	Failure to deliver CERs due to financial or technical failure.
Legal Risk	No legal standards for CDM. No case law in any country. Complex national and international law issues.
Capital Markets/Finance Risk	Significant volume needed for economies of scale.

of the CDM as they are inherent to the structure of the CDM arrangement and largely beyond the control of project developers.

Validation/Verification Estimation Error

In order for CERs to be issued, the emissions reductions are first "validated." Validation is an estimate made at the design stage for purposes of approving the project methodology and monitoring plan.[9] Expectations are created from the emissions reduction estimate, including the expectations of investors and those who are considering purchasing the CDM CERs produced by the project. After the project has begun operation, a DOE periodically verifies the project's actual emissions. The verification determines the actual number of CERs to be issued for each particular verification period.[10]

In order to assess risk associated with validation/verification error, this author compared the validation estimates and verified results of the 175 CDM projects that had issued CERs as of May 1, 2007. The comparison suggests that validation procedures tend to overestimate the number of CERS that will ultimately be issued by a project. Significantly, these results reflect a broad range of CDM projects.

For the first 175 CDM projects that issued CERs, the validation procedure overestimated the number of CERs produced by approximately 27 percent on average. The standard deviation for the population of 175 projects is 42.5 percent.[11]

The large error rate for estimating the issuance of CERs increases the risks associated with sourcing CERs and investing in CDM projects. For example, one major Canadian electric generator that has committed itself to meeting its requirements for allowances through CDM and Joint Implementation ("JI") projects expressed concern that the availability of CDM CERs will be inadequate to meet its company's needs. This company has adopted a 25-year plan to achieve zero net emissions by 2024 and has gained considerable experience assessing approximately a dozen CDM projects. However, due to financial and other risks associated with CDM, the company has undertaken only one CDM project. Given Canada's role as an energy-exporter in such carbon intensive areas as tar sands, the company expects that CDM may not provide a realistic method for meeting its supply requirements for emissions allowances.[12]

The estimation error in the CDM validation/verification process has significant implications for CDM. As of May 1, 2007, there were over 1800 CDM projects that had estimated their emissions reductions through the validation process and will eventually verify their CERs. Because the validations have already occurred in over 1800 projects, they may show error rates of similar magnitude to the 175 projects that are analyzed here.

Potential Explanations for CDM Validation/Verification Error

Interviews were conducted with CDM DOEs, sponsors, and advisors in order to ascertain the reasons for the high error rate in the CDM validation/verification process. Interviews were conducted with three firms that are approved by the CDM Executive Board as DOEs. Collectively, these firms are involved in the validation or verification of 83 percent of the approximately 740 CDM projects that were registered as of May 1, 2006, when the interviews were conducted.[13] In addition, interviews were conducted with four firms that invest in and/or act as project consultants to approximately 30 percent of all CDM projects then listed with the CDM Executive Board.

Surveys of these CDM participants revealed that a variety of factors potentially contribute to CDM validation/verification error. These firms identified the following as contributing factors:

(1) Inadequate Technology or Measurement Methodology;
(2) Environmental Fluctuations;
(3) Supply and Demand Fluctuations;
(4) Delays in Project Completion or Operation;
(5) Use of Conservative Assumptions in Verification Procedures; and
(6) Inadequate Guidance or Changes in Validation/ Verification Procedures.

The leading explanation of validation/verification error was inadequate technology or methodology to measure emissions reductions. For example, with respect to methane landfill projects, several respondents identified the primary cause of error to be the lack of adequate technology to measure low concentrations of gases over large areas. Survey respondents noted that measurements are typically not conducted under ideal conditions (as assumed in the standard methodologies), and very little is known about the quality of waste in landfill sites, which affects decomposition rates and the selection of appropriate methods for analyzing data. Further, models and assumptions used for estimation are often not reliable or appropriate for local conditions.[14]

With respect to environmental conditions, the performance of projects that depend upon wind, precipitation, river flow, or heat (as in the case of decomposition of waste) will be affected by fluctuations in weather conditions. These factors will significantly influence the outcome of verification results.[15]

Supply and demand conditions also influence the verification results of projects whose performance is linked to market conditions. For example, electricity generation projects are verified based on the actual amount of electricity supplied to the grid.[16] Furthermore, delay of project completion or operation can significantly affect the economic feasibility of a project and its verification results.[17] In particular, hydroelectric plants are highly sensitive to construction delays.[18]

Several firms identified the use of inappropriate assumptions in the validation stage and conservative assumptions in the verification stage as potential factors influencing validation/verification error. Several respondents noted that CDM methodologies often use generalized Intergovernmental Panel on Climate Change ("IPCC") estimates that do not take local conditions into account. For example, the use of IPCC estimates for methane projects fails to take into account local agricultural conditions.[19] Several individuals noted that because the validation stage involves estimation, it is inherently subject to error, and one respondent noted that project sponsors are often optimistic in the validation stage.[20] Others suggested that firms conducting the verification may use conservative assumptions in accordance with best practices recommended by the International Organization for Standardization and other organizations, thereby further increasing the difference between validation estimates and verification results.[21]

With respect to the adequacy of guidance or change in procedures, several respondents noted that the CDM Executive Board has not provided adequate guidance for validation and verification procedures. CDM methodologies have been frequently revised, which has greatly contributed to uncertainty. One respondent noted that some of these methodologies have been revised several times already since their inception and that CDM guidelines do not specify exactly what steps need to be taken to validate or verify emissions.[22] Another person indicated that CDM rules which prohibit direct contact between project sponsors and reviewing personnel have slowed approvals and prevented project sponsors from receiving timely or detailed guidance.[23]

Prospects for Improvement

Several respondents suggested specific aspects of the CDM that can be improved to reduce validation/verification error. One respondent suggested more detailed methodology regarding monitoring requirements should improve data collection and the consistency in assumptions used at the validation and verification stages.[24] Several individuals emphasized that proven technologies should exhibit less variability between validation estimates and verification results.[25] Finally, one respondent indicated that training and assistance in locating qualified people to carry out estimates for each methodology would help reduce error.[26]

Finally, CDM participants were asked their opinion as to whether they expected estimates would improve in the future. Respondents generally believed that results should improve, while at the same time acknowledged that estimation error is likely to continue due to the inherent nature of prediction. One respondent stated that observers should continue to see estimation error, especially for projects that are influenced heavily by outside factors. In general, respondents believed that the variability is inherent in the design of the CDM validation and verification arrangement; validation estimates are made based on theoretical engineering estimates, whereas the verification is based on actual plant operations.

Emissions Allowances Price Volatility And Excess Supply

Interviews with industry participants revealed that CDM CERs are priced based on multiple factors: spot and futures prices of European Union Emission Allowances ("EUAs"), the rules governing carbon offsets, risks of the particular project producing the CERs, expectations regarding supply and demand for CERs, and expected supply and demand for other carbon offsets, especially AAUs.

The starting point for pricing CERs is the spot and futures prices of EUAs as this market is the most highly liquid and provides near-term price visibility. CDM CERs are priced based on expected supply and demand for carbon offsets. CERs must compete against supply from various other sources, including JI Emission Reduction Units ("ERUs"), RMUs, and excess Assigned Amount Units ("AAUs").

Over-allocation of emissions allowances presents one of the greatest risks to the viability of the CDM. The availability of a

FIGURE 1: EUROPEAN UNION EMISSIONS ALLOWANCE PRICES, APRIL - MAY 2006[28]

large number of low-cost allowances will lower the price of carbon and potentially increase price volatility of CO_2 emissions allowances. In turn, this will make more costly CDM projects unattractive financially and will increase the risks of CDM projects in general.

Over-allocation of emissions allowances has occurred in both the European Union and Eastern Europe. The announcement of the first verification of EU national emissions in May 2006 caused the EU Emissions Trading System ("EU ETS") market price of EUAs to drop by over 67 percent because verified emissions were 41 million metric tonnes of CO_2, or approximately 2.5 percent, lower than expected.[27]

The drop in EUA prices in May 2006 placed downward pressure on CER prices and slowed CDM activity considerably. As a result, many CDM projects are no longer financially competitive.[29]

To place the EU over-allocation in perspective, CDM projects that had filed with the CDM Executive Board as of May 1, 2007 represented 305,801,000 metric tonnes of validated CO_2 emissions reductions per year.[30] The EU carbon over-allocation displaces over one eighth of the total amount of these estimated CDM emissions reductions. However, if the verification process results in a lower issuance of CERs, as has been observed in projects verified to date, the displacement could be considerably higher. If the validation/verification error of the first 175 CDM projects is representative of the other 1660 validated and unverified CDM projects filed as of May 1, 2007, the expected number of CDM CERs to be issued would be approximately 223 million metric tonnes of CO_2 per year. The May 2006 over-allocation would displace 18 percent of the expected CERs from the CDM projects validated as of May 1, 2007.

Eastern European excess emissions allowances could have an even greater effect on carbon prices. Most excess emissions allowances are held by Russia and Ukraine. Russian and Ukrainian excess emissions are expected to exceed 791.5 million metric tonnes of CO_2 per year by 2010 from fossil fuel emissions alone. Table 2 sets forth the Energy Information Administration's estimate of projected Russian and Ukrainian CO_2 emissions from fossil fuel consumption, and the resulting estimated excess CO_2 allowances.

If Russian and Ukrainian excess allowances enter the market in 2008, they would exert significant downward pressure on CERs and prices. To place this in perspective, if 791.5 million tonnes of Russian and Ukrainian annual excess allowances produced from fossil fuel CO_2 emissions enter the market, this additional supply would be approximately twenty times larger in volume than the 41 million tonne over-allocation of CO_2 in May 2006 that caused the price of EUAs to drop by over 67 percent. The same 791.5 million metric tonnes CO_2 per year would be almost three times greater than the validated annual emissions reductions of the 1835 CDM projects filed as of May 1, 2007, and almost four times greater than the expected annual volume

TABLE 2: RUSSIA AND UKRAINE PROJECTED CO_2 ALLOWANCES (METRIC TONNES)[31]

Year	Russia Emissions	Ukraine Emissions	Total Emissions	Projected Excess Allowances
1990	2,347,000,000	674,400,002	3,021,400,002	
2002	1,522,000,000	426,024,926	1,948,024,926	1,073,375,075
2010	1,732,000,000	497,898,263	2,229,898,263	791,501,738
2015	1,857,000,000	539,804,109	2,396,804,109	624,595,893
2020	1,971,000,000	568,392,418	2,539,392,418	482,007,583
2025	2,063,000,000	599,999,369	2,662,999,369	358,400,632

Note: Ukraine is 17.76% of former Soviet Union projections. These projections only take account of excess allowances from carbon dioxide emissions from fossil fuel consumption. Other greenhouse gas sources may increase the allowances.

of CERs to be issued by these CDM projects assuming that validations continue to overestimate actual issuances of CERs by a 27 percent error margin.

In addition, other GHGs are expected to produce additional allowances for Eastern European countries in excess of 100 million metric tonnes of CO_2 equivalent per year, a majority of which will belong to Russia and Ukraine.[32] These excess emissions allowances are approximately 33 percent of validated CDM emissions reductions as of May 1, 2007, and almost one half the number of CERs expected to be issued, assuming validation estimates continue to exhibit an error rate of 27 percent. To the extent these other gases are permitted to enter the market, the resulting excess AAUs from Eastern Europe will place additional downward pressure on the price of CDM CERs.

Rules Governing Emissions Allowances

The rules governing the CDM and other emissions allowance instruments also affect the prices of CERs. Under the Kyoto Protocol, CDM CERs and JI ERUs may be used in future compliance periods up to a maximum of 2.5 percent of a party's AAUs of emissions.[33] However, Article 12(10) of the Kyoto Protocol ensures that CERs and ERUs obtained prior to 2008 can be fully banked for use in the 2008-2012 compliance period.[34] In contrast, AAUs are fully bankable without limitation starting during the 2008-2012 compliance period.[35] Still, the EU has allowed its member states to decide whether unused EUAs acquired during the 2005-2007 trial phase can be carried over and used to meet emissions limits in the first commitment period in 2008-2012.[36] Potential temporary restrictions on the ability to bank EUAs for the 2008-2012 period enhance the value of CERs relative to EUAs during the trial phase.

Over-allocation of emissions allowances presents one of the greatest risks to the viability of the CDM.

To the extent excess emissions allowances held by Eastern European countries enter the market, these excess allowances will affect prices and the operation of the EUA market, and in turn, the CDM and JI programs. The Kyoto Protocol does not place explicit limits on the entry of excess allowances; however, parties are required to limit their use of tradable allowances to levels that are "supplemental" to "significant" domestic measures to reduce GHG emissions.[37] The EU has been particularly active in seeking to promote domestic reductions through the supplementarity provision. However, there are differences of opinion among European officials whether a quantitative limit on trading allowances is desirable.[38] While it is not clear how the supplementarity restriction will be implemented by Kyoto Parties, it will influence how Eastern European excess allowances compete with EUAs and other forms of AAUs, CERs, ERUs and Removal Units.

The imposition of penalties by the EU provides some level of price support for EUAs and CERs. The EU imposes penalties for failure to deliver adequate EUAs of 40 euros per tonne of CO_2 in the trial phase which runs until December 21, 2007, and 100 euros per tonne in the first commitment period from January 1, 2008 through December 31, 2012.[39]

CDM CER prices are also influenced by the perceived quality of the project and project sponsors. As previously discussed, there is a great deal of uncertainty regarding the delivery of verified CERS, which increases supply risk for the purchaser of CERs. One way to address this risk is to price CERs differently based on the stage of the project; sales early in the process prior to final approval receive a much lower price than those sold post-verification. The creditworthiness of the seller also significantly affects the price of CERs.[40]

Academic Study Projections of Future Prices

A number of studies have estimated future carbon prices, with the results varying widely based on differing assumptions and models. These assumptions include different estimates of future economic growth, oil prices, cost of emissions abatement, the rules concerning the availability of Eastern European excess emissions allowances, the rules concerning trading across emissions sectors and countries, and banking of emissions. One 1999 study that compared the results of eleven leading models predicted prices would range below twenty euros to 100 euros per tonne of CO_2 in order to achieve five percent emissions reductions from 1990 levels. Seven of the eleven models surveyed predicted the price would range from twenty euros to 35 euros per tonne of CO_2 for a five percent reduction of 1990 levels in a market in which the United States participated.[41] More recent studies have predicted median prices to range from under one euro to under six euros per tonne of CO_2 if trading across sectors and countries is permitted under the EU ETS.[42] The study which predicted that CO_2 prices should be under one euro per tonne was based on analysis of the current EU ETS regime and assumed that emitters will find relatively inexpensive methods to meet target reductions.[43]

These estimates are well below observed trading prices in the 15-40 euros range. Again, the imposition of a 40 euros/tonne penalty for failure to meet targets during the 2005-2007 period may have supported the price at the observed levels. Alternatively, these studies may underestimate the cost of reducing emissions.[44]

Limited Price Visibility

Interviews conducted by this author and industry reports confirm that CDM projects have generally sold CERs for delivery though 2012, reflecting the duration of the regulatory regime rather than the potential duration of CERs contracts.[45] Although there is little activity beyond 2012, some survey respondents and other commentators have confirmed that purchasers of CERs have entered into options agreements for CERs to be produced in the post-2012 period.[46]

The survey shows that because CDM projects require a minimum of approximately eighteen to 24 months to register and verify CERs, most activity in the CDM market is for future delivery of CERs starting approximately two years ahead of time.

The EUA market provides limited, near-term price visibility for emissions credits. Trading EUAs is primarily conducted through brokered transactions over the Over the Counter ("OTC") market. In 2005, OTC trades accounted for an estimated 80 percent of combined OTC and exchange trades.[47] Little data is publicly available for OTC trades.

Several organized exchanges also trade EUAs. The European Climate Exchange is the largest exchange, representing 63 percent of exchange-traded emissions contracts. This exchange trades standardized futures contracts for delivery of EUA.[48] As of April 2006, 100 metric tonnes of carbon contracts were available for quarterly delivery through March 2008, and then annual delivery from 2008 through 2012.[49]

An analysis of the European Climate Exchange's Carbon Financial Instruments ("ECX CFI") futures contracts reveals that liquidity in this market is mostly short-term. Open interest in ECX CFI futures contracts is most liquid in the first year. At the time of analysis, 79 percent of open interest in exchange-traded EUAs was for delivery by December 2007, the time period during which regulatory certainty is greatest. Survey responses confirm the OTC EUA market follows the same short-term pattern as the exchange-traded futures markets.

Table 3: Open Interest in European Climate Exchange CFI Contracts, April 2006[50]

Period	Open Interest
June, September, December 2006	46%
March, June, September, December 2007	32%
March, June, September, December 2008	17%
December 2009	3%
December 2010	1%
December 2011	1%
December 2012	1%

The statistics in Table 3 reflect the short-term nature common to most trading markets as well as the fact that supply and demand in EUA markets is strongly influenced by regulatory considerations. The significant volume of trades for the 2008 to 2012 period may be influenced by EU rules that impose a penalty of 100 euros per tonne of CO_2 equivalent for failure to deliver adequate allowances in the first commitment period from January 1, 2008 through December 31, 2012.[51]

The short-term nature of the EUA market provides limited price visibility for longer-term CDM projects. This introduces an added price risk for investors in CDM projects and purchasers of CERs.

Regulatory Uncertainty

Regulatory uncertainty has adversely affected the CDM at several levels. Because the Kyoto Protocol is only in force until 2012, there is uncertainty regarding the future of the CDM. The short time horizon for the CDM through 2012 reduces incentives to develop CDM projects.[52] One project sponsor noted that if there was greater commitment to the Kyoto Protocol by his own government, he believes his firm would be much more aggressive in developing CDM and JI projects.[53]

Uncertainty regarding CDM standards and methodologies is another source of regulatory uncertainty. All firms surveyed identified that uncertainty in standards and methodology were causing significant delays and additional cost. For example, the cost of a new methodology is typically recovered by its application in multiple projects. Interviewees stated that the cost of developing a methodology is approximately U.S. $150,000.[54] Further, the time required to develop new methodologies is substantial. Methodologies have required an average of 280 days for approval.[55] Yet, a number of methodologies are under revision and review, some of which have been revised multiple times.[56] Several firms expressed concern that these problems could undermine the viability of the CDM.

Significantly, because CDM projects require a minimum of approximately eighteen to 24 months to register and verify the CERs, CDM regulatory requirements need to be clarified well in advance of the upcoming compliance period to ensure a large volume of CDM activity.[57]

Finally, the CDM will also be affected by the rules concerning trading emissions between countries. In addition to the EU, a number of countries are developing emissions trading regimes in anticipation of the 2008-2012 compliance period.[58] The regulatory arrangements for linking these national trading systems, the rules concerning the supply of gases, and the excess AAUs that will enter the market will affect the viability of CDM.[59]

Prospects for CDM to Address Climate Change

The CDM is in the development stage and must overcome several significant hurdles before it is a viable mechanism for addressing climate change, promoting sustainable development, and fostering clean energy technologies in developing countries on a meaningful scale. Specifically, difficulty in reliably estimating and delivering CERs, oversupply of emissions allowances, lack of clear CDM standards and methodologies, and regulatory uncertainty concerning the future of the Kyoto Protocol are critical issues that must be addressed successfully in order for the CDM to be a commercial and policy success.

Endnotes: The Clean Development Mechanism *on page 75*

[1] Kyoto Protocol to the United Nations Framework Convention on Climate Change art. 12, Dec. 11, 1997, 37 I.L.M. 22 [hereinafter Kyoto Protocol].

[2] Kyoto Protocol, *id.* at arts. 6, 12.

[3] U.N. Framework Convention on Climate Change, Conference of the Parties, Seventh Session, Marrakesh, Morocco, Oct. 29, 2001 - Nov. 10, 2001, *Addendum to the Report of the Conference of the Parties*, U.N. Doc. FCCC/CP/2001/13/Add.2 (Jan. 21, 2002) [hereinafter Marrakesh Accords]; United Nations Framework Convention on Climate Change Secretariat, Designated Operational Entities, http://cdm.unfccc.int/DOE/index.html (last visited Apr. 16, 2007).

[4] Marrakesh Accords, *supra* note 3.

[5] Farhana Yamin, *Part I: The International Rules on the Kyoto Mechanisms, in* CLIMATE CHANGE AND CARBON MARKETS: A HANDBOOK OF EMISSIONS REDUCTION MECHANISMS 1 (Farhana Yamin ed., 2005).

[6] Marrakesh Accords, *supra* note 3.

[7] *See* EVAN MILLS & EUGENE LECOMTE, FROM RISK TO OPPORTUNITY: HOW INSURERS CAN PROACTIVELY AND PROFITABLY MANAGE CLIMATE CHANGE (2006) (noting that Swiss Re currently offers products that insure against the risks of a CDM project's failure to deliver promised CERs); *see also* Personal Communication between author and Corey Gooch, Associate Director, Aon Enterprise Risk Management (Apr. 4 2006, May 19, 2006) (on file with author) (commenting that other insurers are considering providing similar products).

[8] *See* AgCert, Presentation at the Engineering Institute of Canada Climate Change Technology Conference (May 10-12, 2006); *see also* TransAlta, Presentation at the Engineering Institute of Canada Climate Change Technology Conference: Emissions Trading for Technology Change: Integrated Strategy (May 10-12, 2006) [hereinafter TransAlta, Presentation at Engineering Institute]; Patricia Hoyte, Presentation at the Engineering Institute of Canada Climate Change Technology Conference: Caiteur Group Presentation on CDM (May 10-12, 2006); Olivia Fussell, Presentation at Green Trading Summit: Carbon Credit Capital Presentation on How to Create & Trade Carbon Credits (Apr. 5, 2006); Annika Colston, Presentation at Green Trading Summit: Ecosecurities plc Presentation on Green Project Design for CDM (Apr. 5, 2006); Martijn Wilder et al., *Carbon Contracts, Structuring Transactions: Practical Experience, in* LEGAL ASPECTS OF IMPLEMENTING THE KYOTO PROTOCOL MECHANISMS 295 (David Freestone & Charlotte Streck eds., 2005).

[9] Marrakesh Accords, *supra* note 3.

[10] Marrakesh Accords, *supra* note 3.

[11] The standard deviation was calculated based on the percentage difference between annual verified emissions reductions and annual estimated emissions reductions, using all 175 data points, based on author's calculations of data in UNEP Risoe Centre. UNEP Risoe Centre, Overview of CDM Pipeline as of May 1, 2007, *available at* http://www.cd4cdm.org/publications.htm (last visited May 10, 2007) [hereinafter CDM Pipeline August].

[12] Personal Communication with author (May 16, 2006) (on file with author).

[13] UNEP Risoe Centre, Overview of CDM Pipeline as of May 1, 2007, *available at* http://www.cd4cdm.org/publications.htm (last visited May 10, 2007) [hereinafter CDM Pipeline May].

[14] Personal Communication between author and Werner Betzenbichler, Head of the Certification Climate & Energy, TÜV-SÜD (May 16, 2006) (on file with author) [hereinafter Betzenbichler]; Personal Communication between author and Marco Van Der Linden, CDM/JI Program Director, SGS (May 16, 2006) (on file with author) [hereinafter Van Der Linden]; Personal Communication between author and Len Eddy, Managing Director, AgCert (May 15, 2006) (on file with author) [hereinafter Eddy].

[15] Personal Communication between author and E. Telners, Manager, Climate Change Services, Det Norske Veritas (May 15, 2006) (on file with author) [hereinafter Telners]; Van Der Linden, *supra* note 14.

[16] Van Der Linden, *supra* note 14.

[17] Betzenbichler, *supra* note 14.

[18] Van Der Linden, *supra* note 14; Personal Communication between author and Annika Colston, U.S. Country Manager, Ecosecurities (Apr. 4, 2006, May 19, 2006) (on file with author) [hereinafter Colson].

[19] Telners, *supra* note 15.

[20] Personal Communication between author and Ricardo Esparta , Technical Director, Ecoinvest (May 22, 2006) (on file with author) [hereinafter Esparta].

[21] Personal Communication between author and Patrick Hardy, Manager, Climate Change Services Canada, Det Norske Veritas (May 10-11, 2006) (on file with author) [hereinafter Hardy].

[22] Van Der Linden, *supra* note 14.

[23] Esparta, *supra* note 20.

[24] Betzenbichler, supra note 14. The World Resources Institute, the World Business Council for Sustainable Development, the International Organization of Standardization, the American Petroleum Institute, and the California Climate Action Registry are developing guidance for estimation and measurement of emissions reductions. All of these standards are voluntary methods intended to help define best practices. *See* First Environment, ISO 14064: The New Climate Change Standard, http://www.firstenvironment.com/html/climate_change_faq_1-iso_14064.html (last visited May 20, 2006).

[25] Telners, *supra* note 15; Hardy, *supra* note 21; TransAlta, Presentation at Engineering Institute, *supra* note 7.

[26] Eddy, *supra* note 14.

[27] Press Release, European Commission, EU Emissions Trading Scheme Delivers First Verified Emissions Data for Installation (May 15, 2006); Heather Timmons, *Data Leaks Shake Up Carbon Trade*, NY TIMES, May 26, 2006, at C1.

[28] Point Carbon, http://www.pointcarbon.com (last visited May 20, 2006).

[29] Colston, *supra* note 18.

[30] CDM Pipeline August, *supra* note 11.

[31] *See* ENERGY INFORMATION ADMINISTRATION, INTERNATIONAL ENERGY OUTLOOK 2005 (2005) (Ukraine is 17.76% of former Soviet Union projections. These projections only take account of excess allowances from carbon dioxide emissions from fossil fuel consumption. Other greenhouse gas sources may increase the allowances.).

[32] Chris Rolfe, Note 4: *Hot Air, in* THE EARTH IN BALANCE: BRIEFING NOTES FOR THE NOVEMBER 2000 CLIMATE SUMMIT (2000).

[33] Marrakesh Accords, *supra* note 3, at Decision 19/CP.7.

[34] Kyoto Protocol, *supra* note 1, at art. 12(10).

[35] Marrakesh Accords, *supra* note 3, at Decision 19/CP.7.

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